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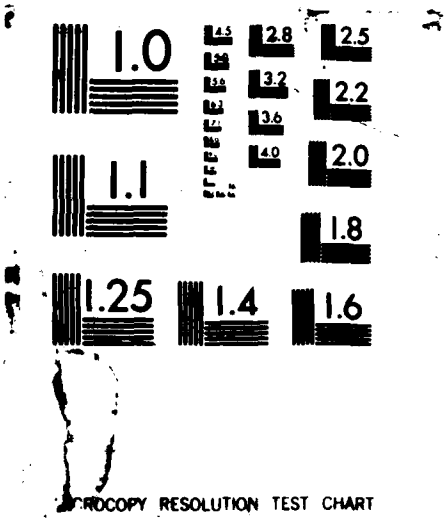
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LONGITUDINAL STUDY OF THE HEALTH STATUS OF U.S. NAVY COMBAT PILOTS

A. HOIBERG
R. G. BURR

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NAVAL HEALTH RESEARCH CENTER
P.O. BOX 85122
SAN DIEGO, CALIFORNIA 92138

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
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Anne Hoiberg and Ralph G. Burr
Naval Health Research Center
P.O. Box 85122
San Diego, California 92138-9174

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SUMMARY

Problem

Being a combat pilot is perceived to be a highly stressful, hazardous occupation. Examples of the stressors associated with this occupation include being exposed to high levels of acceleration and flying through enemy artillery.

Objectives

The research issue addressed was to determine whether or not the short- and long-term effects of these combat-related stressors on the human body and psyche were manifested by higher hospitalization rates among U.S. Navy combat pilots. The specific purpose was to compare the rates of morbidity (hospitalizations and medical/physical evaluation boards) and mortality of combat pilots during a 15-year postcombat period with those of an age-matched sample of noncombat pilots.

Approach

Flight and combat information from 1968 to 1980 was obtained from the Individual Flight Activity Reporting System file which was provided to the Naval Health Research Center by the Naval Safety Center in Norfolk, VA. Four groups of U.S. Navy pilots were identified: 3,043 pilots with more than 275 combat hours (HCH), 2,792 with less than 275 combat hours (LCH), 79 repatriated prisoner of war combat pilots, and a control sample of 4,475 noncombat pilots. Records of all hospitalizations, medical boards, physical evaluation boards, and deaths for each group were selected from the Naval Medical Inpatient file. Annual rates per 10,000 strength were computed for 16 diagnostic categories and several specific diseases in each pilot group for three 5-year follow-up intervals. Ninety-five percent confidence limits were computed, and comparisons were conducted to identify significant differences in rates across groups.

Results

During the first 5-year period after combat, pilots in the control group had the highest total hospitalization rate and the highest rates for several diagnostic categories. Returned prisoners of war had an elevated rate for a cluster of parasitic diseases. During the 5-9 year period after combat, LCH pilots had higher hospitalization rates than controls for the category of accidental injuries and the subcategory of aviation-related injuries; controls had the highest rate of respiratory diseases. Ten years after combat both combat pilot groups had significantly higher total hospitalization rates than controls. No specific disease was shown to be attributable to the combat experience.

Conclusions

The very low hospitalization rates observed during the first 5-year postcombat interval, especially in the HCH group, reflected the excellent health status of combat pilots and indicated that the short-term health effects potentially associated with combat were not manifested. The higher accidental injury rates reported during subsequent 5-year intervals suggested that combat pilots were more likely than controls to seek activities that entailed a certain element of physical risk. The high rate of digestive disorders, which consisted primarily of admissions for hernias and appendicitis, also could not be attributed to combat.

Recommendations

Future research efforts should be designed to include the medical records of combat pilots who left the Navy. Life style factors also should be examined in an effort to assess the impact of these variables on hospitalization rates among combat pilots. Results of these efforts should provide additional information on the incidence of accidental injuries and neoplasms, which would either corroborate or refute the trends observed in this study.

Longitudinal Study of the Health Status of U.S. Navy Combat Pilots

Being a combat pilot is perceived to be a highly stressful, hazardous occupation. Examples of the stressors associated with this occupation include being exposed to high levels of acceleration and flying through enemy artillery. Landing on an aircraft carrier after a combat mission introduces another set of stressors, especially if the circumstances consist of landing at night--on a pitching and rolling airstrip--during a turbulent storm.

As well-trained professionals, pilots endure these job-related hazards because of their intense motivation to fly. This dedication is reflected in research on a sample of Vietnam combat pilots, 80% of whom responded that they never dreaded going on a combat "hop" (11). This percentage is high despite other results showing difficulty in sleeping (primarily because of interruptions) for 28% of this sample as well as being tired of flying to the point of wishing to be grounded for a few days (38%), having to use alcohol to relax (18%), and experiencing weight loss (50%).

The research issue addressed in this study was to determine whether or not the short- and long-term effects of these combat-related stressors on the human body and psyche were manifested with higher hospitalization rates. Few researchers have identified the short-term effects of combat on the pilot's physical and mental well-being. The considerable body of research published since the Vietnam conflict primarily concentrated on the posttraumatic stress disorder, which was observed with greatest frequency in the ground forces (5). For combat pilots, most of the studies have dealt with such combat-related circumstances as the health effects associated with being a prisoner of war. According to Berg and Richlin (1,2),

the initial health problems suffered by Navy pilots who became prisoners of war were those resulting as a consequence of engaging in fire fights, ejecting, or crashing the aircraft. Subsequent health conditions, induced by the captivity experience, included such diagnoses as helminthiasis, amoebiasis, avitaminoses, and dermatophytosis.

In examining long-term health effects, results of the study of "1,000 U.S. Navy aviators" provided some insight into the health status of pilots 35 or more years after combat pilot training (4,9,10). The total mortality rate for those pilots was significantly lower than expected as were mortality rates for such specific conditions as cardiovascular disease, cancer, and nonaviation accidental injuries (9). MacIntyre and his associates (10) also reported a considerably lower than expected rate of morbidity among those aviators than was recorded for U.S. males.

The purpose of this study was to identify the short- and long-term health effects that may be associated with being a combat pilot. To be specific, this longitudinal study examined the rates of morbidity (hospitalizations and medical/physical evaluation boards) and mortality of U.S. Navy combat pilots throughout a 15-year follow-up period after combat. These rates were compared with those of an age-matched sample of noncombat pilots.

DATA AND METHODS

Study Population

This population consisted of all pilots identified on the Individual Flight Activity Reporting System (IFARS) file as having flown in combat at some time during their Navy careers. This file, which was provided to the Naval Health Research Center by the Naval Safety Center, Norfolk, VA, included all pilots who served on active duty for some period of time from 1968 to 1980. The combat pilot population was divided into

pilots who had a total of 275 or more combat hours (n = 3,043) and those with less than 275 combat hours (n = 2,792). Also included in the combat pilot population were 79 pilots who became prisoners of war in Vietnam; because of the unique circumstances of the captivity experience, the medical data for these men were examined separately from the others. A sample of pilots who had not flown in combat was selected from the IFARS file to serve as a comparison group. Selection of this control group was restricted to birth year, which yielded a total of 4,475 pilots. The mean ages were 34.0 for control pilots, 34.6 for pilots with low combat hours (LCH), and 34.2 for pilots with high combat hours (HCH). Other variables extracted from this file included the date when each pilot began his flying career as well as the year when each combat pilot first flew in combat.

The medical information analyzed for this study was obtained from the Naval Medical Inpatient file which is maintained at the Naval Health Research Center. Records of all hospitalizations, medical boards, physical evaluation boards, and deaths for each of the 3 samples were extracted from this file. All diagnoses and dates for each medical event were compiled according to 3 follow-up time intervals. For combat pilots, the 3 time frames included 0-4, 5-9, and 10-14 years after their first year of combat. Because the first year of combat occurred on an average of 2 years subsequent to the initial year of flying for pilots with combat hours, only the medical events recorded 2 or more years after beginning to fly were included in the computations of rates for the control sample. The nomenclature used for the numeric coding of all diagnoses was the Eighth Revision of the International Classifications of Diseases Adapted for Use in the United States (ICDA-8).

Procedure

Using the cause and date of separation obtained from the Naval Officer Career History file, the number of pilots listed

on active duty was tabulated for each follow-up year in the 3 subsamples. These person-years were totaled for each time interval. With frequencies of diagnoses for hospitalizations, medical boards, physical evaluation boards, and deaths, annual rates per 10,000 were computed for each diagnostic category and several specific diseases by time interval and group. Ninety-five percent confidence limits were computed for each diagnostic category and subcategory of hospitalizations, medical boards, physical evaluation boards, and deaths. Comparisons of these values were conducted across groups to determine if the 2 combat pilot groups had significantly higher rates for any diagnostic category than the control group.

RESULTS

Annual Hospitalization Rates by Time Interval

The first 5-year interval. During the 0-4 year interval after combat, pilots in the control group had the highest total hospitalization rate across groups (see Table I). When rates for the major diagnostic categories were examined, control pilots had significantly higher rates than the HCH group for accidental injuries, respiratory diseases, musculoskeletal disorders, and infective and parasitic diseases. Rates for circulatory diseases were significantly higher for control pilots than LCH pilots. No significant differences across groups were observed in rates for medical board and physical evaluation board appearances; rates were low for board actions in each of the three groups. The control group had the highest, albeit nonsignificant, mortality rate.

The 5-9 year interval. A significant increase in total hospitalization rates from the first 5-year period to the 5-9 year interval was observed for both of the combat pilot groups. As shown in Table II, rates for LCH pilots were significantly higher than controls for accidental injuries and aviation-related injuries. Control pilots had a significantly higher hospitalization rate than HCH pilots for respiratory disorders.

TABLE I. HOSPITALIZATION RATES PER 10,000 BY DIAGNOSTIC CATEGORY FOR U.S. NAVY PILOTS 0-4 YEARS AFTER FIRST YEAR OF COMBAT, 1967-1979

	Controls		LCH Pilots		HCH Pilots	
Diagnostic Category (ICDA-8)	No.	Rate	No.	Rate	No.	Rate
Accidents, Poisonings, and Violence	74	69.1*	30	40.3	22	27.4
Aviation-related injuries	12	11.2	3	4.0	0	0
Diseases of the Digestive System	33	30.8	14	18.8	22	27.4
Diseases of the Musculoskeletal System	33	30.8*	19	25.5	10	12.4
Diseases of the Genitoruinary System	32	29.9	16	21.5	12	14.9
Diseases of the Circulatory System	20	18.7**	3	4.0	7	8.7
Cardiovascular disease	4	3.7	0	-	0	0
Diseases of the Respiratory System	34	31.8*	15	20.2	6	7.5
Infective and Parasitic Diseases	22	20.5*	12	16.1	4	5.0
Symptoms and Ill-defined Conditions	18	16.8	4	5.4	5	6.2
Supplementary Classifications	6	5.6	4	5.4	3	3.7
Diseases of the Nervous System	12	11.2	4	5.4	2	-
Neoplasms	5	4.7	2	-	3	3.7
Malignancies	0	0	0	0	1	-
Mental Disorders	5	4.7	4	5.4	1	-
Alcoholism	1	-	2	-	0	0
Diseases of the Skin	7	6.5	9	12.1	5	6.2
Endocrine, Nutritional, and Metabolic Diseases	1	-	-	-	0	0
Total	308	287.7†	137	184.2	104	129.3
Person-years at risk	10,707		7,438		8,041	

*Controls had significantly higher hospitalization rates ($p < .05$) than pilots with >275 combat hours (HCH). **Controls had a significantly higher rate ($p < .05$) than LCH (<275 combat hours). †Controls had a significantly higher rate ($p < .05$) than LCH and HCH groups. Rates were not computed for frequencies of less than 3. Rates for the categories of Congenital Anomalies and Diseases of the Blood and Blood-forming Organs were not included in the table, but were in the total.

TABLE II. HOSPITALIZATION RATES PER 10,000 BY DIAGNOSTIC CATEGORY FOR U.S. NAVY PILOTS 5-9 YEARS AFTER FIRST YEAR OF COMBAT, 1967-1979

	Controls		LCH Pilots		HCH Pilots	
Diagnostic Category (ICDA-8)	No.	Rate	No.	Rate	No.	Rate
Accidents, Poisonings, and Violence	40	50.0	66	89.7*	56	60.2
Aviation-related injuries	1	-	9	12.2*	7	7.5
Diseases of the Digestive System	46	57.5	55	74.8	48	51.6
Diseases of the Musculoskeletal System	34	42.5	25	34.0	40	43.0
Diseases of the Genitourinary System	38	47.5	17	23.1	40	43.0
Diseases of the Circulatory System	13	16.2	24	32.6	32	34.4
Cardiovascular disease	4	5.0	10	13.6	15	16.1
Diseases of the Respiratory System	33	41.3**	13	17.7	16	17.2
Infective and Parasitic Diseases	10	12.5	15	20.4	14	15.1
Symptoms and Ill-defined Conditions	6	7.5	13	17.7	21	22.6
Supplementary Classifications	15	18.8	12	16.3	19	20.4
Diseases of the Nervous System	11	13.8	6	8.2	16	17.2
Neoplasms	19	23.8	6	8.2	11	11.8
Malignancies	8	10.0	5	6.8	5	5.4
Mental Disorders	5	6.2	10	13.6	10	10.8
Alcoholism	2	-	8	10.9	3	3.2
Diseases of the Skin	7	8.8	6	8.2	4	4.3
Endocrine, Nutritional, and Metabolic Diseases	5	6.2	9	12.2	4	4.3
Total	286	357.6	283	384.7	339	364.7
Person-years at risk	7,998		7,356		9,296	

*Pilots with <275 combat hours (LCH) had significantly higher hospitalization rates ($p < .05$) than controls. **Controls had significantly higher hospitalization rates ($p < .05$) than pilots with ≥275 combat hours (HCH). Rates were not computed for frequencies of less than 3. Rates for the categories of Congenital Anomalies and Diseases of the Blood and Blood-forming Organs were not included in the table, but were in the total.

Differences in medical board, physical evaluation board, and mortality rates were nonsignificant across groups.

The 10-14 year interval. Ten to 14 years after combat, both combat pilot groups had significantly higher total hospitalization rates than controls (see Table III). HCH pilots had a significantly higher hospitalization rate than controls for digestive disorders; the specific digestive condition that accounted for the largest proportion of this rate was the subcategory of hernias. In comparisons of rates greater than 15 per 10,000 strength, HCH pilots' rates were more than double those for control and LCH pilots for neoplasms, malignancies, and alcoholism; these differences, however, were nonsignificant. No significant differences were observed across groups for rates of medical boards, physical evaluation boards, and deaths.

Combat Pilot Repatriated Prisoners of War

The 79 Navy combat pilot prisoners of war were returned to the United States in 1973. As noted at the outset, their hospitalization and other medical records were not included in the computations of rates for the LCH and HCH pilots. In examining their hospitalization diagnoses recorded at the time of repatriation, the most prevalent disorder was a cluster of parasitic diseases, which consisted of ancylostomiasis, other intestinal helminthiasis, intestinal parasitism, and other infective-parasitic disease. These pilots also had higher rates than other pilots for "other diseases of the peripheral nerves." Also noteworthy was the finding that only 2 of the 79 returned prisoners of war were hospitalized for a mental disorder during the 7-year follow-up: one for alcoholism and another for neuroses.

DISCUSSION

Results of this study identified several diseases and diagnostic categories that differentiated combat pilots from pilots who had no recorded hours of combat. During the first 5-year interval, combat pilots had very low hospitalization

TABLE III. HOSPITALIZATION RATES PER 10,000 BY DIAGNOSTIC CATEGORY FOR U.S. NAVY PILOTS 10-14 YEARS AFTER FIRST YEAR OF COMBAT, 1967-1979

	Controls		LCH Pilots		HCH Pilots	
Diagnostic Category (ICDA-8)	No.	Rate	No.	Rate	No.	Rate
Accidents, Poisonings, and Violence	32	42.4	35	66.1	43	63.9
Aviation-related injuries	2	-	3	5.7	4	5.9
Diseases of the Digestive System	34	45.0	37	69.9	56	83.3*
Diseases of the Musculoskeletal System	28	37.1	19	35.9	33	49.0
Diseases of the Genitourinary System	19	25.2	21	39.7	27	40.1
Diseases of the Circulatory System	23	30.5	23	43.4	29	43.1
Cardiovascular disease	13	17.2	12	22.7	13	19.3
Diseases of the Respiratory System	11	14.6	13	24.6	14	20.8
Infective and Parasitic Diseases	6	7.9	6	11.3	13	19.3
Symptoms and Ill-defined Conditions	17	22.5	9	17.0	8	11.9
Supplementary Classifications	10	13.2	13	24.6	15	22.3
Diseases of the Nervous System	12	15.9	12	22.7	10	14.8
Neoplasms	11	14.6	5	9.4	20	29.7
Malignancies	5	6.6	3	5.7	11	16.3
Mental Disorders	12	15.9	6	11.3	15	22.3
Alcoholism	4	5.3	4	7.6	11	16.3
Diseases of the Skin	4	5.3	5	9.4	10	14.8
Endocrine, Nutritional, and Metabolic Diseases	3	4.0	4	7.6	6	8.9
Total	228	301.9	209	394.7**	306	454.4**
Person-years at risk	7,551		5,295		6,734	

*Pilots with more than 275 combat hours (HCH) had significantly higher hospitalization rates ($p < .05$) than controls. **HCH pilots and those with less than 275 combat hours (LCH) had significantly higher rates ($p < .05$) than controls. Rates were not computed for frequencies of less than 3. Rates for the categories of Congenital Anomalies and Diseases of the Blood and Blood-forming Organs were not included in the table, but were in the total.

rates, especially the HCH group. These findings indicated that the short-term health effects potentially associated with combat were not evidenced in these pilots. For the 5-9 year interval, total hospitalization rates for both combat groups increased significantly from the first 5-year period after combat. Ten to 14 years after combat, the two combat pilot groups had significantly higher total hospitalization rates than controls.

In explaining the rate differences observed during the first 5-year interval, an important consideration centered on the excellent health status of the HCH group. Their lower hospitalization rates were interpreted as a reflection of their exceptionally high level of physical and mental fitness rather than an indication of a lower level of physical and mental well-being in the control sample. In other comparisons, moreover, rates for the control group were similar to those for the total Navy pilot population while those for the HCH group were considerably lower (8).

During the other 5-year intervals, combat pilots had significantly higher total hospitalization and accidental injury rates than during the first 5-year interval. While combat pilots' accidental injury rates increased significantly from the first to second interval, rates for control pilots decreased across the years. Results of other research also showed that rates for accidental injuries declined with increasing age among Navy pilots (8). The injuries reported among combat pilots primarily occurred as a result of such nonaviation-related accidents as falling, slipping, participating in an athletic activity, or using a machine or tool. Perhaps the higher rates among combat pilots were a reflection of their having the time and opportunity to engage in activities that entailed a certain element of physical risk. Another explanation was that combat pilots were more likely than controls to seek high risk activities out of frustration for having to adjust to a duty assignment involving administrative work or one providing few

opportunities to perform highly demanding flight tasks.

HCH pilots had the highest hospitalization rate for neoplasms 10-14 years after combat. However, the number of pilots hospitalized for a malignancy was very low, and no specific type of malignancy was identified as differentiating this group from the other 2. Also, the high hospitalization rate for digestive disorders, which consisted primarily of admissions for hernias and appendicitis (55.4% of the total), could not be attributed to the aftereffects of combat.

Few hospitalizations were evidenced for mental disorders. As contrasted with the research that examined incidence rates of posttraumatic stress disorder among Vietnam veterans (5), results of this study identified few pilots who were admitted with this condition. Overall, these results supported the theoretical position that responding to the stressors of combat or the captivity situation is dependent on the individual's coping mechanisms as well as the meaning of the experience for him or her (6). Roscoe (12), for example, reported that, in studies using heart rate as an index of stress in pilots, the factors of risk, anxiety, and the threat of danger did not directly influence heart rate responses. Aerial combat maneuvers, moreover, were not determined to be correlated with pilots' sympathetic activity nor state of fatigue, although these work tasks were deemed to be moderately stressful (3).

Future research efforts on combat pilots should be designed to include the medical records of pilots who left the Navy prior to a typical retirement age. Life style factors of all combat pilots also should be examined in an effort to assess the impact of these variables on hospitalization rates for conditions identified in this study. Analyses of those data would provide additional information on the incidence of accidental injuries and neoplasms, which would either corroborate or refute the trends observed in this study.

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